We claim:

1. A method of transmitting data comprising:
- providing a datastream comprised of bits;
- interleaving the bits of the datastream across a plurality of orthogonal frequency division multiplexed radio frequency transmitters, wherein each of the radio frequency transmitters transmits a plurality of radio frequency subcarriers, to provide interleaved bits;
- transmitting data that corresponds to the interleaved bits using the plurality of radio frequency subcarriers of the plurality of orthogonal frequency division multiplexed radio frequency transmitters.

2. The method of claim 1 wherein providing a datastream comprised of bits includes providing a datastream comprised of bits as provided from a single source.

3. The method of claim 1 wherein providing a datastream comprised of bits includes providing a datastream comprised of bits as provided from a plurality of sources.

4. The method of claim 3 wherein providing a datastream comprised of bits as provided from a plurality of sources includes providing a datastream comprised of bits as provided from a plurality of sources wherein at least some of the bits as provided from at least one of the plurality of sources are encoded bits.

5. The method of claim 1 wherein providing a datastream comprised of bits includes providing a datastream comprised of encoded bits.

6. The method of claim 5 wherein providing a datastream comprised of encoded

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bits includes providing a datastream comprised of convolutionally encoded bits.

7. The method of claim 5 wherein providing a datastream comprised of encoded bits includes providing a datastream comprised of serially concatenated convolutionally encoded bits.

8. The method of claim 5 wherein providing a datastream comprised of encoded bits includes providing a datastream comprised of parallel concatenated convolutionally encoded bits.

9. The method of claim 5 wherein:
- providing a datastream comprised of encoded bits includes providing a datastream comprised of encoded bits; and
- interleaving the bits of the datastream across a plurality of orthogonal frequency division multiplexed radio frequency transmitters includes interleaving the encoded bits of the datastream across the plurality of orthogonal frequency division multiplexed radio frequency transmitters.

10. The method of claim 9 wherein interleaving the encoded bits of the datastream includes alternating assignment of consecutive encoded bits to the radio frequency transmitters and on a plurality of the subcarriers having channel responses with low correlation.

11. The method of claim 1 wherein transmitting data that corresponds to the interleaved bits includes transmitting symbols wherein each symbol represents a plurality of the interleaved bits.

12. An apparatus for transmitting data comprising:
- an encoder having a single datastream input and an encoded bits datastream

output;

- a multiple-input multiple-output modulator having an input operably coupled to the encoded bits datastream output of the encoder and having a serial-to-parallel output that provides first and second items of modulation information that correspond to the encoded bits;

- a first orthogonal frequency division multiplexed transmitter having:

    - an input operably coupled to a first output of the serial-to-parallel output of the multiple-input multiple-output modulator to receive the first items of modulation information; and

    - a multiple subcarrier radio frequency transmission output; and

- a second orthogonal frequency division multiplexed transmitter having:

    - an input operably coupled to a second output of the serial-to-parallel output of the multiple-input multiple-output modulator to receive the second items of modulation information; and

    - a multiple subcarrier radio frequency transmission output;

such that information comprising the encoded bits datastream are interleaved across the multiple subcarriers of the first and second orthogonal frequency division multiplexed transmitters.

13. The apparatus of claim 12 wherein the encoder comprises a serially concatenated convolutional encoder.

14. The apparatus of claim 12 wherein the encoder comprises a parallel concatenated convolutional encoder.

15. The apparatus of claim 12 wherein the encoder comprises a convolutional encoder.

16. The apparatus of claim 12 wherein the first and second items of modulation

information that correspond to the encoded bits comprise symbols wherein each symbol represents a plurality of encoded bits.

17. A method comprising:
- providing a first and second orthogonal frequency division multiplexed transmitter wherein each transmitter transmits a plurality of subcarriers at frequencies that are substantially identical as between the first and second transmitter;
- providing a single stream of data comprised of sequential bits;
- interleaving the sequential bits across the plurality of subcarriers for both the first and second orthogonal frequency division multiplexed transmitters.

18. The method of claim 17 wherein interleaving the sequential bits across the plurality of subcarriers for both the first and second orthogonal frequency division multiplexed transmitters includes interleaving the sequential bits across the plurality of subcarriers for both the first and second orthogonal frequency division multiplexed transmitters such that consecutive encoded bits of each datastream will be transmitted from transmitters and subcarriers with substantially minimal correlation.

19. A method of receiving data comprising:

- using at least one orthogonal frequency division multiplexed transmission receiver having at least one antenna to receive multi-antenna transmission signals across a plurality of subcarriers ;
- demodulating the received multi-antenna transmission signals to provide bit metrics corresponding to a single bit stream.

20. The method of claim 19 further comprising de-interleaving the bit metrics of

the single bit stream.

21. The method of claim 20 wherein providing bit metrics includes estimating a probability for each bit given 0 or 1 has been transmitted, by using a maximum likelihood bit soft information estimator represented by

$$P(\mathbf{y}_k \mid b_{i,k}) = \sum_{s \in S_i} P(\mathbf{y}_k \mid \mathbf{s}_k = \mathbf{s}) P(\mathbf{s}_k = \mathbf{s}),$$

where $P(\mathbf{y}_k|b_{i,k})$ is a probability of observing received signals $\mathbf{y}_k$ at the kth subcarrier on at least one antenna under the condition of transmitting bit $b_{i,k}$ (0 or 1), and S_i is a set of all symbol vectors whose bit representations contain the given value of the bit of interest $b_{i,k}$.

22. The method of claim 20 wherein providing bit metrics includes using a zero forcing bit metric estimator represented by

$$P(\hat{s}_{j,k} \mid b_{i,k}) = \sum_{s_0 \in S_i} \exp\left[-\mid \hat{s}_{j,k} - s_0 \mid^2 /(2\left\|\mathbf{W}_k(:,j)\right\|^2 \sigma_n^2)\right] P(\hat{s}_{j,k} = s_0)$$

where $\hat{s}_{j,k}$ is the estimated symbol at the kth subcarrier of the jth transmitted antenna, i.e. $[\hat{s}_{1,k} ..., \hat{s}_{Mr,k}]^T = \mathbf{W}_k^H \mathbf{y}_k$, with the filter matrix $\mathbf{W}_k$ being the zero forcing matrix computed based on the channel matrix H_k, and where $\mathbf{W}_k(:,j)$ denotes the jth column of $\mathbf{W}_k$, "||.||" denotes the vector norm, σ_n^2 is the noise power, and S_i is a set of constellation symbolswhose bit representations contain the given value of the bit of interest $b_{i,k}$.

23. The method of claim 20 wherein providing bit metrics includes using a minimum mean squared error bit metric estimator represented by

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$$P(\hat{s}_{j,k} \mid b_{i,k}) = \sum_{s_0 \in S_i} \exp\left[-\mid \hat{s}_{j,k} - s_0 \mid^2 \Big/ \left(2\left\| \mathbf{W}_k(:,j) \right\|^2 \sigma_n^2 + 2\left\| \mathbf{H}_k^H \mathbf{W}_k(:,j) - \mathbf{e}_j \right\|^2 \sigma_s^2 \right) \right] P(\hat{s}_{j,k} = s_0)$$

where $\hat{s}_{j,k}$ is the estimated symbol at the kth subcarrier of the jth transmitted antenna, i.e. $[\hat{s}_{1,k}, ..., \hat{s}_{Mr,k}]^T = \mathbf{W}_k^H \mathbf{y}_k$, with the filter matrix $\mathbf{W}_k$ being the minimum mean squared error matrix computed based on the channel matrix H_k (scale each row of $\mathbf{W}_k^H$ so that the diagonal elements of $\mathbf{W}_k^H \mathbf{H}_k$ equal 1), and where $\mathbf{W}_k(:,j)$ denotes the jth column of $\mathbf{W}_k$, "||.||" denotes the vector norm, σ_n^2 denotes the noise power, $\mathbf{e}_j$ is a vector whose only nonzero entry 1 is at the jth position, σ_s^2 is the average symbol power, and S_i is a set of contellation symbols whose bit representations contain the given value of the bit of interest $b_{i,k}$.

24. The method of claim 19 and further comprising decoding to recover at least one information source based on the de-interleaved bit metrics.

25. The method of claim 24 wherein decoding includes serially concatenated convolutionally decoding the single stream of data.

26. The method of claim 24 wherein decoding includes parallel concatenated convolutionally decoding the single stream of data.

27. The method of claim 24 wherein decoding includes convolutionally decoding the single stream of data.

28. A method of receiving data comprising:
substantially simultaneously:
    - using a first orthogonal frequency division multiplexed transmission receiver having at least one antenna to receive multi-antenna transmission signal across a plurality of subcarriers to obtain first modulation items;
    - using a second orthogonal frequency division multiplexed transmission

receiver having at least one antenna to receive multi-antenna transmission signal across a plurality of subcarriers to obtain second modulation items, wherein the plurality of subcarriers are substantially identical for both the first and second receiver;

5 - demodulating the radio frequency transmissions as received by the first and second receivers to recover a single stream of data comprised of bits that are recovered from both the first and second modulation items, wherein demodulation includes the use of a zero forcing symbol metric estimator based on ("ln" stands for the natural logarithm)

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$$\ln P(\hat{s}_{j,k} \mid s_0) = - \mid \hat{s}_{j,k} - s_0 \mid^2 / (2\|\mathbf{W}_k(:,j)\|^2 \sigma_n^2)$$

where $\hat{s}_{j,k}$ is the estimated symbol at the kth subcarrier of the jth transmitted antenna, i.e. $[\hat{s}_{1,k}, ..., \hat{s}_{Mr,k}]^T = \mathbf{W}_k^H \mathbf{y}_k$, with the filter matrix $\mathbf{W}_k$ being the zero forcing matrix computed based on the channel matrix $\mathbf{H}_k$, and where $\mathbf{W}_k(:,j)$ denotes the

15 j^{th} column of $\mathbf{W}_k$, "$\|.\|$" denotes the vector norm, σ_n^2 is the noise power, and s_0 is any of the constellation symbols.

29. A method of receiving data comprising:

20 substantially simultaneously:

- using a first orthogonal frequency division multiplexed transmission receiver having at least one antenna to receive radio frequency transmissions across a plurality of subcarriers to obtain first modulation items;

- using a second orthogonal frequency division multiplexed transmission

25 receiver having at least one antenna to receive radio frequency transmissions across a plurality of subcarriers to obtain second modulation items, wherein the plurality of subcarriers are substantially identical for both the first and second receiver;

- demodulating the radio frequency transmissions as received by the first and

second receivers to recover a single stream of data comprised of bits that are recovered from both the first and second modulation items, wherein demodulation includes the use of a minimum mean squared error symbol metric estimator based on ("ln" stands for the natural logarithm)

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$$\ln P(\hat{s}_{j,k} \mid s_0) = -\mid \hat{s}_{j,k} - s_0 \mid^2 /(2\|\mathbf{W}_k(:,j)\|^2 \sigma_n^2 + 2\|\mathbf{H}_k^H \mathbf{W}_k(:,j) - \mathbf{e}_j\|^2 \sigma_s^2)$$

where $\hat{s}_{j,k}$ is the estimated symbol at the kth subcarrier of the jth transmitted antenna, i.e. $[\hat{s}_{1,k}, ..., \hat{s}_{Mr,k}]^T = \mathbf{W}_k^H \mathbf{y}_k$, with the filter matrix $\mathbf{W}_k$ being the minimum mean squared error matrix computed based on the channel matrix $\mathbf{H}_k$ (scale each row of $\mathbf{W}_k^H$ so that the diagonal elements of $\mathbf{W}_k^H \mathbf{H}_k$ equal 1), and where $\mathbf{W}_k(:,j)$ denotes the jth column of $\mathbf{W}_k$, "||.||" denotes the vector norm, σ_n^2 denotes the noise power, $\mathbf{e}_j$ is a vector whose only nonzero entry 1 is at the jth position, σ_s^2 is the average symbol power, and s_0 is any of the constellation symbols.

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